

Serial No. 09/515,348
Attorney Docket No. F0039
Firm Reference No. AMDSP0388US

Reply to Office Action Dated February 25, 2004
Reply dated March 30, 2004

REMARKS

Claims 1-20 are pending.

I. REJECTION OF CLAIMS UNDER 35 U.S.C. § 102

Claims 1-3, 7-9 and 13-20 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Pierrat et al., U.S. Patent No. 6,091,845 A, ("Pierrat"). Withdrawal of the rejection is respectfully requested for at least the following reasons.

Pierrat discloses a technique for inspecting photomasks by comparing a pair of simulated resist images 180 and 185 (corresponding to respective wafer structures). Col. 6, lines 6-14. One of the simulated images 180 is created using a mask image acquired by an inspection machine. The other simulated image 185 is created using original mask pattern data from a mask pattern database 150. Col. 6, lines 39-45, lines 49-53 and lines 62-67. Pierrat does not disclose any sort of evaluating of a photomask by comparison with a desired wafer structure.

Claim 1 recites a method of analyzing a wafer manufacturing process. The method includes, *inter alia*, "evaluating the portion of the mask by comparing the simulated wafer structure to a desired wafer structure." Pierrat does not disclose comparing a simulated wafer structure to a desired wafer structure.

Pierrat discloses inspecting photomasks by comparing a simulated wafer structure of simulated exposure using a photomask, relative to a simulated wafer structure using mask pattern data. Pierrat's mask pattern data 210 is not a desired wafer structure as recited in claim 1. The Pierrat mask pattern data 210 is used to manufacture the photomask. See, for example, Fig. 3 and Col. 7, lines 39-45. Further, the mask pattern data quantifies the features of the mask in two-dimensional space. The two-dimensional features will not directly correspond to a three dimensional mask produced from the mask pattern data. Further, the two-dimensional features will not directly correspond to a wafer structure created from the three dimensional mask that varies from the mask pattern data. Accordingly, a desired wafer structure as recited in claim 1 would not correspond to the two-dimensional features of the mask pattern data disclosed by Pierrat. Thus, Pierrat is comparing simulated resist images based on mask images to detect defects in the mask.

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In contrast, the present invention involves comparing an image of a simulated wafer structure to a desired wafer structure. See, for example, page 4, line 31 to page 5, line 9, page 9, lines 9-12, page 11, lines 24-29, page 19, lines 11-15. The desired wafer structure of the present invention is an optimum wafer structure but is not necessarily an exact duplicate of the photomask and/or the photomask design data. For example, a desired wafer structure may have critical dimensions (CDs) less than a CD of the photomask due to an etch process used trim a photoresist mask. Alternatively, an etch species used in an etch step of a wafer may undercut the photoresist mask to produce a feature in a wafer with a CD less than a CD of a corresponding feature in a photoresist mask. Additionally, a length of a line in a wafer may be less than a length of a line in a photomask due to a mask design accounting for line end pullback.

The information obtained from the comparison is used to generate optical proximity correction (OPC) mask designs, for example, that compensate for mask patterning errors and give better performance. By evaluating variations between a simulated wafer structure and a desired wafer structure, a mask design with OPC can be designed that does not require fabrication of a precise reproduction in a photomask in order to produce the desired structure in the wafer. Thus, the need for specialized mask generation processes is reduced. As a result, costs associated with generating specialized masks is reduced.

Therefore, since Pierrat does not teach or suggest one or more of the features as claimed in claim 1, claim 1 and the claims that depend therefrom are patentable over Pierrat for at least the reasons stated above.

II. REJECTION OF CLAIMS UNDER 35 U.S.C. § 103

Claim 1 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Garza et al., U.S. Patent No. 6,081,659 A, ("Garza") and Pierrat. Withdrawal of the rejection is respectfully requested for at least the following reasons.

Garza discloses comparing a simulated image of a photoresist pattern to an actual photoresist pattern for masking process characterization. See, for example, Fig. 7, Col. 9, lines 6-59. Specifically, Garza discloses the information obtained from the comparison of the simulated image to the actual photoresist pattern is used to produce a modified simulation routine which

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more accurately predicts and simulates the pattern such that a subsequently executed iteration of simulator 140 produces a modified aerial image that more accurately approximates the actual pattern 172 than the original aerial image. Col. 9, lines 55-59. Garza does not disclose a method for evaluating a photomask by comparing a simulated wafer structure to a desired wafer structure as recited in claim 1.

Garza teaches away from comparing a simulated image with another simulated image. That is, Garza discloses that a simulator will produce an estimate of a pattern (the aerial image) that varies from an actual pattern produced by a masking process regardless of the number of parameters incorporated into a simulator 140. Thus, Garza discloses a feedback mechanism whereby discrepancies observed between an actual pattern and an aerial image are analyzed to produce a modified simulator that results in less discrepancy or error between the aerial image produced during a successive iteration of the simulator and the actual image produced by the pattern. Col. 8, line 61 to Col. 9, line 5. As discussed above, Pierrat discloses the use multiple simulated images of photoresist. Accordingly, there would be no motivation to combine the teachings of Garza with the teachings of Pierrat.

Therefore, since Garza alone does not teach or suggest one or more of the features as claimed in claim 1 and there is not motivation to combine the teachings of Garza with the teachings of Pierrat, claim 1 is patentable over Garza and Pierrat for at least the reasons stated above.

Claims 4-6 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Pierrat and Fiekowsky. Claims 10 and 11 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Pierrat and Sheng, U.S. Patent No. 6,477,265 A, ("Sheng"). Claim 12 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Pierrat and Sheng, and further in combination with Fiekowsky, U.S. Patent No. 6,263,292 B1, ("Fiekowsky"). Withdrawal of the rejections is respectfully requested for at least the following reasons.

Claims 4-6 and 10-12 are patentable over Pierrat for at least the reasons stated above with regard to claim 1. Sheng and Fiekowsky alone or in combination do not make up for the deficiencies of Pierrat. That is, neither Sheng and/or Fiekowsky teach or suggest evaluating a

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mask by comparing a simulated wafer structure (image) to a desired wafer structure. Sheng discloses a system and method for detecting defects in integrated circuit wafers related to photolithographic processing of the wafers. Abstract. Fiekowsky discloses a measurement tool that objectively and repeatedly measures defects for determining photomask disposition. Col. 4, lines 19-25. Furthermore, the resulting method from the combined teachings of Pierrat and Sheng and/or Fiekowsky would not result in the method that evaluates a mask as recited in amended claim 1. Thus, there would be no motivation to combine the teachings of Pierrat with Sheng and/or Fiekowsky.

Therefore, since Pierrat alone or in combination with Sheng and/or Fiekowsky does not teach or suggest one or more features as claimed in claim 1, the claims that depend therefrom are believed to be in condition for allowance for at least the reasons stated above.

III. CONCLUSION

In light of the foregoing, it is respectfully submitted that the present application is in condition for allowance and notice to that effect is hereby requested. If it is determined that the application is not in condition for allowance, the Examiner is invited to initiate a telephone interview with the undersigned attorney to expedite prosecution of the present invention.

Any fee(s) resulting from this communication is hereby authorized to be charged to our Deposit Account No. 18-0988; Our Order No. F0039 (AMDSP0388US).

Respectfully submitted,
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